Cognitive Radioecology

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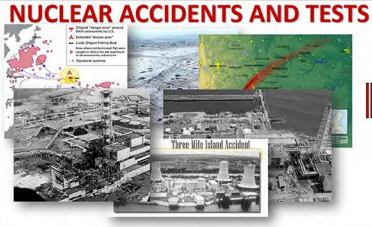
ABSTRACT

According to Wikipedia **Radioecology** is a branch of ecology, which studies how radioactive substances interact with nature; how different mechanisms affect the substances' migration and uptake in food chains and ecosystems. Investigations in radioecology might include aspects of field sampling, designed field and laboratory experiments and the development of predictive simulation models. This science combines techniques from some of the more basic, traditional fields, such as physics, chemistry, mathematics, biology, and ecology, with applied concepts in radiation protection. Radioecological studies form the basis for estimating doses and assessing the consequences of radioactive pollution for human health and the environment.

Significant economic and social disruptions arise after radioactive contamination of land as a result of releases of radioactivity into the environment be it from accidents, routine and war operations or during decommissioning and waste management of nuclear facilities. Measures carried out to reduce and minimise radiation doses to the public can give rise to even more concerns as often they are not understood and the stakeholders are often not involved into the decision making process. Countermeasures are needed to reduce population exposure, at the same time minimising economic and social costs. The effectiveness of countermeasures is not only highly dependent on factors which are connected to environmental transfer, but also to special behaviour and consumption behaviours in varying food production systems. It is clearly desirable that countermeasures are implemented in the most effective way, targeting expensive resources to areas and/or food products for which they are most required at the same time minimizing their social and economic and ecological impact.

A central aspect of radioecology is the identification of vulnerable areas which, by virtue of the processes governing the transfer of radiocaesium through food chains, deliver high individual, or collective doses to man. Social factors (e.g. dietary preferences) and agricultural production techniques also contribute to vulnerability. Modern geographical information systems combing all such information reliably based on experimental and measurement studies and scientific knowledge support the identification of such areas allowing to redirect resources and inform authorities and the public about the actual and future developments.

NUCLEAR ACCIDENTS AND TESTS



Exposure factors

- Time
- Location
- Transport of radionuclides through environment
- Traits of the individual (physiological parameters, dietary information, residence data, use of local recourses etc.)

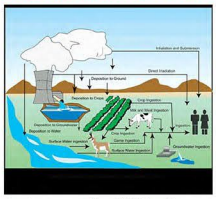
A specific set of these characteristics is referred to as an exposure scenario.

Radioecological roadmap

- Identifying the relevant exposure pathways
- Determining important pathways and eliminating those that are not important
- Measurements
- Modelling
- Dose assessment

Restoration

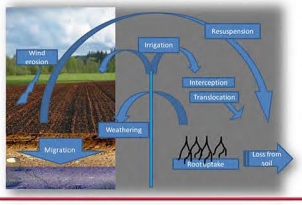
ENVIRONMENTAL TRANSPORT



http://www.gsseser.com/Annuals/2003/Chapter3.htm

- TERRESTRIAL
- ATMOSPHERIC
- AQUVATIC

TERRESTRIAL PATHWAY



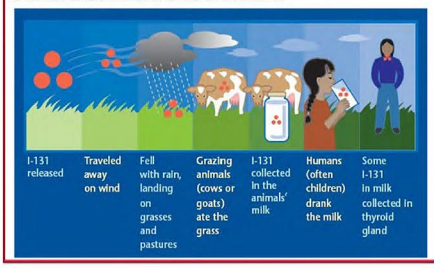
Direct exposure from radionuclides in deposited on the ground: external

Ingestion of food or other materials (soil) that have been contaminated by radioactive materials: internal

Parameters for assessing of radionuclide behaviour in soil and plants:

- Soil characteristics
- Climate
- Topography
- Agricultural practice (tillage, application of fertilizer, irrigation)

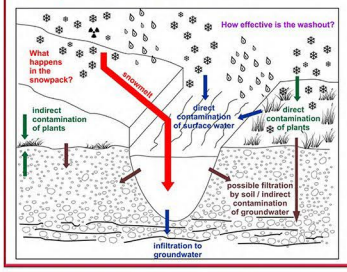
ATMOSPHERIC PATHWAY



Direct radiation from radionuclides in the plume or deposited on the ground: external

Inhalation of radionuclides in the air or ingestion of food or other materials (soil) that have been contaminated by radioactive materials: internal

AQUATIC PATHWAY



Aquatic food chain to humans:

Drinking water

Consumption of vegetables, meat, milk and soil affected by the use of contaminated irrigation water

Consumption of fish, shellfish and seaweeds

External exposure though swimming and boating

Direct exposure from contaminated shore sediment

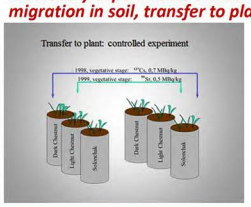
RADIOECOLOGICAL ACTIVITIES

SAMPLING and in-SITU measurements

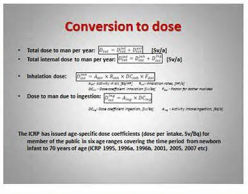
FIELD

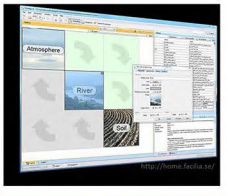
LABORATORY

Measurements of activity concentration in samples, laboratory experiments on radionuclide migration in soil, transfer to plant, transfer to animals



CALCULATION AND MODELLING





ENVIRONMENTAL DECISION SUPPORT SYSTEM

Because of the multiple factors affecting the efficiency and suitability of each countermeasure, generalised recommendation - which do not account for diversity - often, result in inadequate decisions when applied at a local scale. These considerations have led to a need for a development of practical environmental decision support systems (EDSS) which take into account the temporal and spatial variation in the above factors and are capable of providing advice on countermeasure strategies at different levels of the decision making process.

Due to developments in information technology (IT) and tools such as GIS and Multi-Criteria Decision Support (MCDS) systems, it has become possible to integrate spatial, temporal and additional criteria into one decision making system.